BODY REFERENCE : SPEC2_STAT_TEMP_REV 0

TITLE :	SPECIFICATION OF IBERDROLA FUNCTIONS: "COMPUTE STATOR WINDING TEMPERATURE (F3)"
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CONTENTS

0. OBJECTIVE OF THE FUNCTION

The objective of the function is to using the nine actual RTD sensors installed in generator stator (three per phase).

The objective of the function is to compute the different temperature values from stator winding sensors (nine sensors located inside three phase windings), and obtain one value represented by a fuzzy function.

1. FUNCTION ENVIRONMENT

The function will compute and report the stator winding temperature. So, the information presented to the user contains the temperature value by means of the model.

The sequence of requests and responses of the function is the following:

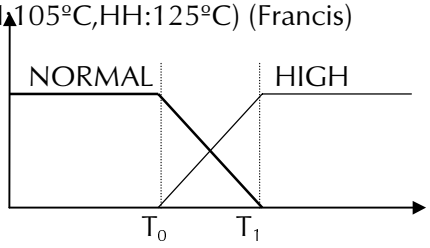
Event	Request/Response (RQ/RS)	From	To
Monitoring Request	RQ	Function	Function
Collect Data (continuous extern function with a fixed sample interval)	RQ	Function	Data Acquisition System (D.A.S.)
Data Collected (continuous function with a fixed sample interval)	RS	Data Acquisition System (D.A.S.)	Data Base
Select Data (on monitoring request)	RQ	Function	Function
Data Selected (on monitoring request)	RS	Data Base	Function
Perform Monitoring	RQ	Function	Function
Store Results (stator temperature)	RS	Function	Data Base

2. INPUT DATA DEFINITION

the input data will be the following:

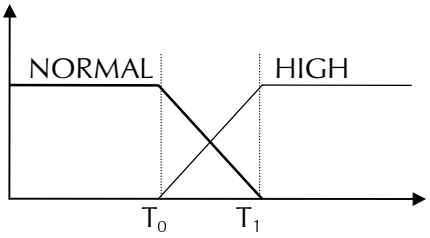
CODE:
r1
NAME:
Phase R winding stator temperature indicated by RTD number 1
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0214 WIND_TEMP_R1 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0211 WIND_TEMP_R1 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



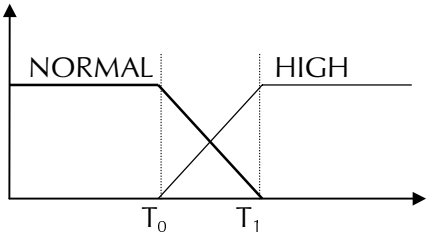
CODE:
r2
NAME:
Phase R winding stator temperature indicated by RTD number 2
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0215 WIND_TEMP_R2 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0212 WIND_TEMP_R2 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



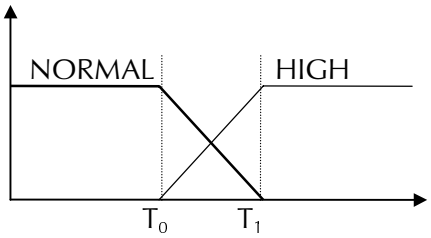
CODE:
r3
NAME:
Phase R winding stator temperature indicated by RTD number 3
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0216 WIND_TEMP_R3 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0213 WIND_TEMP_R3 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



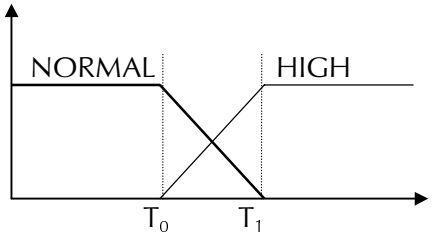
CODE:
s1
NAME:
Phase S winding stator temperature indicated by RTD number 1
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0301 WIND_TEMP_S1 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0214 WIND_TEMP_S1 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



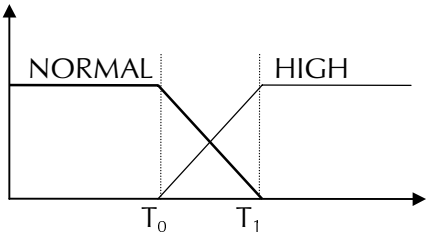
CODE:
s2
NAME:
Phase S winding stator temperature indicated by RTD number 2
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0302 WIND_TEMP_S2 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0215 WIND_TEMP_S2 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



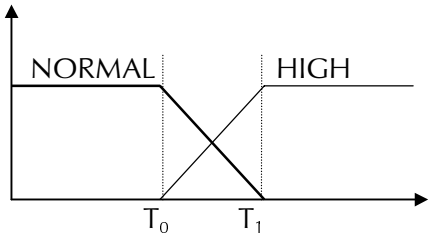
CODE:
s3
NAME:
Phase S winding stator temperature indicated by RTD number 3
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0303 WIND_TEMP_S3 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0300 WIND_TEMP_S3 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



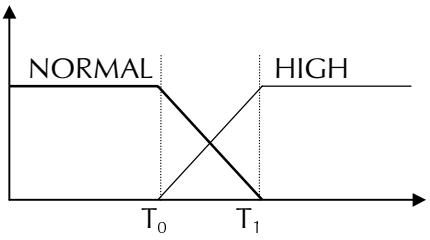
CODE:
t1
NAME:
Phase T winding stator temperature indicated by RTD number 1
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0304 WIND_TEMP_T1 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0301 WIND_TEMP_T1 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



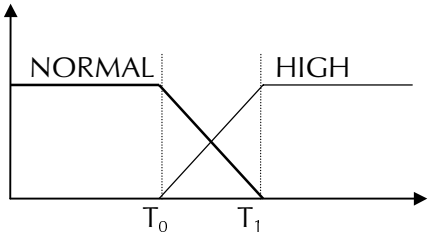
CODE:
t2
NAME:
Phase T winding stator temperature indicated by RTD number 2
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0305 WIND_TEMP_T2 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0302 WIND_TEMP_T2 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC



CODE:
t3
NAME:
Phase T winding stator temperature indicated by RTD number 3
TYPE:
analogic
RANGE:(limits)
0-150 ºC
ACQUISITION, SOURCE:
SCADA
XA-V0306 WIND_TEMP_T3 (alarm H:105ºC,HH:125ºC) (Pelton)
XA-V0303 WIND_TEMP_T3 (alarm H:105ºC,HH:125ºC) (Francis)
LABELS:
NORMAL
HIGH

T_0 = **pending**
T_1 = 105 ºC

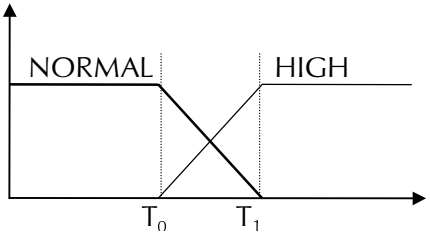


3. OUTPUT DATA DEFINITION

The output of this function will be used to give a global temperature value of the stator winding temperature for monitoring and trending.

GLOBAL STATOR TEMPERATURE

T_0 = **80 ºC**
T_1 = 100 ºC



4. DYNAMIC BEHAVIOUR

As mentioned in section 1., the function will make some simple calculations to transform the initial data selected from the D.A.S. So, the function will be executed when retrieving data from SCADA by the monitoring system, and the results stored into the real-time DB.

5. DATA PROCESSING (ALGORITHMS)

In this section we will define the model used to determine the stator winding temperature using the RTD sensors installed.

The global stator temperature will be the arithmetic mean between the nine sensor value indications, considering for all of them the same multiplier factor Xi when their values are less than T_0 and multiply each value higher than T_0 by a higher factor Xj (for example Xi =1 and Xj = 3)

Example:

T_0 = 80ºC
Xj = 3
Xi =1

IF t1 AND t2 AND t3 AND s1 AND s2 AND s3 AND r1 AND r2 AND r3 < T_0 THEN
Xi =a=b=c=d=e=f=g=h=j=1
T_{STATOR} = (t1+t2+t3+s1+s2+s3+r1+r2+r3) / (a+b+c+d+e+f+g+h+j)

IF t1 > T_0 AND t2 AND t3 AND s1 AND s2 AND s3 AND r1 AND r2 AND r3 < T_0 THEN
t1′ = Xi * t1= 3 * t1
a = Xj = 3
Xi =b=c=d=e=f=g=h=j=1
T_{STATOR} = (t1′+t2+t3+s1+s2+s3+r1+r2+r3) / (a+b+c+d+e+f+g+h+j)

6. INTERFACES

6.1 OPERATOR INTERFACES

The operator interfaces will be the same of those relative to monitoring tasks, since the result of this function will be used in monitoring tasks.

The implementation of this function can be done in C or C++.

The simulation of the system for testing purposes can be done easily by including in the D.B. some historical incident data.

6.2 SYSTEM INTERFACES

The system interfaces are the input and output data specified above.

7. ERROR MANAGEMENT

- Input data into normal limits
- Control software errors (overflow, division by zero).
- To discard abnormal input values (deviation from the mean)
- Control null values or not existent (for a given period) in B.D.
- Control result values (not negative, for example).
- Errors must be included in separate files/tables, identified by a key and containing error type.
- All kind of error signals from the computer must be captured in the function.

8. CONSTRAINTS

The only real-time constraint is the availability of data in the D.B. for the chosen period of time. This means that the process for the data gathering from the sensors must insert data into the D.B. almost continuously (with a sample rate to determine).

9. HARDWARE AND SOFTWARE REQUIREMENTS

C,C++ (Borland), Oracle, PC architecture, Windows-NT.

10. TEST PLAN

The testing of this function will be specified in the WP6 IBERDROLA documents for the Adaptation and Experimentation Specifications of the System.

Among other features the following will be tested:

- Control of incorrect input data/input data format.
- Values by default.
- To prove that the resulting values keep into normal limits (Ed >= Ed_{MIN}).
- Control of limit values.